CLAIMS

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is as follows:

Sub B1

1. A method of progressive time stamp resolution in a multimedia presentation comprising the steps of:

supplying a player of a multimedia presentation with information comprising two labels, one for a multimedia object's start time and one for the multimedia object's end time relative to other multimedia object start and stop times, and three durations, a minimum duration, a maximum duration and a preferred duration for each multimedia object prior to starting playback of the multimedia object; and

resolving the durations of multimedia objects using said information based on actual multimedia object durations and arrival of information of multimedia objects to be played.

2. The method of progressive time stamp resolution in a multimedia presentation recited in claim 1 wherein the step of resolving comprises the steps of:

calculating minimum and maximum end times for over all multimedia objects;

calculating actual end times that are shared by all multimedia objects; and

recalculating a preferred duration of each multimedia object.

3. The method of progressive time stamp resolution in a multimedia presentation recited in claim 1 wherein the step of resolving comprises the steps of:

collecting all the dependency relations for the label Px, by taking all objects n that have Px as the label for their end time:

$$t_n + \text{minimum}(n) \le t_x \le t_n + \text{maximum}(n) \quad n = 1, \ldots, N$$

where t_n is the start time of object n, and N is the number of objects;

using the N relations to calculate the tightest bounds on t_x:

$$\min\{t_x\} \le t_x \le \max\{t_x\}$$

with

$$\min\{t_x\} = \max\{t_n + \text{minimum}(n)\} \quad n = 1, \ldots, N$$

$$\max\{t_x\} = \min\{t_n + \text{maximum}(n)\} \quad n = 1, \ldots, N;$$

recalculating the bounds on the durations of each object n, by using:

$$\text{duration}(n) = t_x - t_n$$

to get

$$\min\{t_x\} - t_n \le \text{duration}(n) \le \max\{t_x\} - t_n \quad n = 1, \ldots, N; \text{ and}$$

recalculating the preferred duration of each object n according to the process:

if (preferred(n) < $\min\{t_x\} - t_n$) then
    preferred(n) = $\min\{t_x\} - t_n$
else if (preferred(n) > $\max\{t_x\} - t_n$) then
    preferred(n) = $\max\{t_x\} - t_n$
end if.

4. The method of progressive time stamp resolution in a multimedia presentation recited in claim 3 wherein the step of resolving further comprises the steps of:

using as the general error criterion for resolving the duration of each multimedia object:

$$E = \sum_{n=1}^{N} \{\text{duration}(n) - \text{preferred}(n)\}^2$$

or, substituting $\text{duration}(n) = t_x - t_n$:

$$E = \sum_{n=1}^{N} \{t_x - t_n - \text{preferred}(n)\}^2$$

and taking the derivative of E with respect to t_x, and setting this to 0 to obtain the optimal solution for the absolute time t_x of label Px as:

$$t_x = \frac{1}{N}\sum_{n=1}^{N} \{t_n + \text{preferred}(n)\}; \text{ and}$$

calculating the corresponding duration of multimedia object n as:

$\text{duration}(n) = t_x - t_n$.

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